

WHAT IS CLAIMED IS:

1. A vented abrasive water-jet nozzle, comprising:
  - a body having an abrasive-material mixing cavity, a water-jet forming orifice, and an airflow restriction orifice defining a water-jet pathway and coupling the orifice and the mixing cavity;
  - an air-vent inlet port; and
  - an air-vent pathway coupled between the air-inlet port and the water-jet pathway,

the airflow restriction orifice having a first minimum cross-section area and the air-vent pathway having a second minimum cross-section area, the second cross-section area being at least twice the first minimum cross-section area.
2. A vented abrasive water-jet nozzle, comprising:
  - a body having an abrasive-material mixing cavity, a water-jet forming orifice, and an airflow restriction orifice defining a water-jet pathway and coupling the orifice and the mixing cavity;
  - an air-vent inlet port; and
  - an air-vent pathway coupled between the air-inlet port and the water-jet pathway,

the air-vent pathway allowing passage of sufficient air between the air-vent inlet port and the water-jet pathway to inhibit upstream migration of abrasive particles from the mixing cavity.
3. A vented abrasive water-jet nozzle, comprising:
  - a nozzle body including an abrasive-material mixing cavity, a receiving portion having a receiving surface that receives a water-jet forming orifice assembly, and an airflow restriction orifice coupling the receiving portion and the abrasive-material mixing cavity and defining a water-jet pathway;
  - an air-vent inlet port; and

an air-vent pathway coupled between the air-inlet port and the water-jet pathway,

the airflow restriction orifice having a first minimum cross-section area and the air-vent pathway having a second minimum cross-section area, the second minimum cross-section area being at least twice the first minimum cross-section area.

4. The nozzle of claim 3, wherein the water-jet pathway further includes an orifice assembly bore of the orifice assembly when the orifice assembly is received in the nozzle body.

5. The nozzle of claim 4, wherein the water-jet pathway further includes an air gap between the orifice assembly bore and the airflow restriction orifice.

6. The nozzle of claim 5, wherein the air-vent pathway is further coupled between the air-inlet port and the air gap.

7. The nozzle of claim 5, wherein the air gap is defined when the orifice assembly is received in the nozzle body, where the orifice assembly includes the air gap in the water-jet pathway.

8. The nozzle of claim 4, wherein the orifice assembly includes an orifice assembly air-vent pathway, and the air-vent pathway includes the orifice assembly air-vent pathway.

9. The nozzle of claim 3, wherein the water-jet pathway includes an air gap in the airflow restriction orifice, and the air-vent pathway is further coupled between the air-inlet port and the air gap.

10. The nozzle of claim 3, wherein the air-vent inlet port is configured for venting with an ambient atmosphere.

11. The nozzle of claim 3, wherein the second minimum cross-section area is at least four times the first minimum cross-section area.

12. A vented abrasive water-jet nozzle, comprising:

a nozzle body including an abrasive-material mixing cavity, a receiving portion having a receiving surface that receives a water-jet forming orifice assembly, and an airflow restriction orifice coupling the receiving portion and the abrasive-material mixing cavity and defining a water-jet pathway;

an air-vent inlet port; and

an air-vent pathway coupled between the air-inlet port and the water-jet pathway,

the air-vent pathway allowing passage of sufficient air between the air-vent inlet port and the water-jet pathway to inhibit upstream migration of abrasive particles from the mixing cavity.

13. A vented water-jet forming assembly, comprising:

a body including a portion that engages a receiving surface of an abrasive water-jet nozzle, a water-jet forming orifice, and a bore having a first minimum cross-section area; and

an air-vent pathway having a second minimum cross-section area that is at least twice the first minimum cross-section area,

the bore coupling the orifice and the air-vent pathway.

14. The assembly of claim 13, wherein the water-jet forming orifice comprises a hole in a jewel.

15. The assembly of claim 13, wherein the body includes two spaced-apart surfaces, the orifice being defined in one surface and the engaging portion being defined in another surface.

16. The assembly of claim 13 wherein the air-vent pathway includes a slot in the another surface.

17. The assembly of claim 16, where the slot defines a cavity about the bore.

18. The assembly of claim 13, wherein the assembly, when engaged with a receiving surface of an abrasive water-jet nozzle body, cooperatively defines with the nozzle body an air-vent pathway between an air-inlet port of the nozzle and a water-jet pathway.

19. The assembly of claim 13, wherein the assembly, when engaged with a receiving surface of an abrasive water-jet nozzle, cooperatively defines an air gap between the orifice assembly bore and an airflow restriction orifice of the nozzle, the air gap being in air communication with the air-vent pathway.

20. The assembly of claim 13, wherein the orifice has an inside diameter between approximately 0.010 and approximately 0.020 inch.

21. The assembly of claim 13, wherein the bore has an inside diameter between approximately 0.015 and approximately 0.040 inch.

22. The assembly of claim 13, wherein the second cross-section area is at least four times the first cross-section area.

23. A vented water-jet forming assembly, comprising:

a body including a portion that engages a receiving surface of an abrasive water-jet nozzle, a water-jet forming orifice, and a bore; and

an air-vent pathway allowing passage of sufficient air along its surface, such that, when the body is received in the abrasive water-jet nozzle, sufficient access by ambient air is provided to a water-jet pathway of the nozzle to inhibit upstream migration of abrasive particles,

the bore coupling the orifice and the air-vent pathway.

24. A vented water-jet forming assembly comprising:

a body including two spaced-apart surfaces, the first surface including a portion that receives a high-pressure water source, and the second surface including a portion that engages a receiving surface of an abrasive water-jet nozzle, a jewel having a water-jet forming orifice, the jewel mounted

on the receiving portion of the first surface, and a bore having a first minimum cross-section area; and

an air-vent pathway having a second minimum cross-section area that is at least twice the first minimum cross-section area,  
the bore coupling the orifice and the air-vent pathway.

25. The assembly of claim 24, where the air-vent pathway is proximate to the second surface.

26. The assembly of claim 24, where the air-vent pathway includes a slot.

27. A vented water-jet forming assembly comprising:

a body including two spaced-apart surfaces, the first surface including a portion that receives a high-pressure water source, and the second surface including a portion that engages a receiving surface of an abrasive water-jet nozzle, a jewel having a water-jet forming orifice, the jewel mounted on the receiving portion of the first surface, and a bore; and

an air-vent pathway allowing passage of sufficient air along its surface, such that, when the body is received in the abrasive water-jet nozzle, sufficient access by ambient air is provided to a water-jet pathway of the nozzle to inhibit upstream migration of abrasive particles,

the bore coupling the orifice and the air-vent pathway.

28. A vented abrasive water-jet nozzle, the nozzle comprising:

means for passing a water-jet between a water-jet forming orifice and an abrasive-material mixing cavity; and

within the passing means, a means for venting the water-jet,

the passing means having a first minimum cross-section area and the venting means having a second minimum cross-section area, the second minimum cross-section area being at least twice the first minimum cross-section area.

29. The nozzle of claim 27, wherein the venting means is coupled to ambient air.

30. A vented water-jet orifice assembly, the assembly comprising:  
means for creating a water-jet from high-pressure water;  
means for mixing abrasive material and the water-jet;  
means for passing the water-jet between the abrasive material  
mixing means and the creating means; and  
means for allowing passage of sufficient ambient air into the  
passing means to inhibit migration of abrasive particles proximate to the  
creating means.